**Memorandum**

U.S. Department of Transportation
**Federal Aviation Administration**

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| Subject: | INFORMATION: Visible Dye Penetrant Inspection of Safety Critical Parts for Engines, Propellers, and APUs | Date: | October 4, 2000 |
| From: | Manager, Engine and Propeller Standards Staff, ANE-110 | Reply to Attn. of: | Mark Liptak,ANE-110 mark.liptak@faa.gov |
| To: | Manager, Aircraft Engineering Division, AIR-100<br>Manager, Aircraft Manufacturing Division, AIR-200<br>Manager, Brussels Aircraft Certification Staff, AEU-100<br>Manager, Engine Certification Office, ANE-140<br>Manager, Engine Certification Branch, ANE-141<br>Manager, Engine Certification Branch, ANE-142<br>Manager, Boston Aircraft Certification Office, ANE-150<br>Manager, New York Aircraft Certification Office, ANE-170<br>Manager, Airframe and Propulsion Branch, ANE-171<br>Manager, Rotorcraft Directorate, ASW-100<br>Manager, Rotorcraft Standards Staff, ASW-110<br>Manager, Airplane Certification Office, ASW-150<br>Manager, Rotorcraft Certification Office, ASW-170<br>Manager, Special Certification Office, ASW-190<br>Manager, Small Airplane Directorate, ACE-100<br>Manager, Small Airplane Standards Office, ACE-110<br>Manager, Atlanta Aircraft Certification Office, ACE-115A<br>Manager, Propulsion Branch, ACE-140A<br>Manager, Chicago Aircraft Certification Office, ACE-115C<br>Manager, Propulsion Branch, ACE-118C<br>Manager, Wichita Aircraft Certification Office, ACE-115W<br>Manager, Propulsion Branch, ACE-140W<br>Manager, Anchorage Aircraft Certification Office, ACE-115N<br>Manager, Transport Airplane Directorate, ANM-100<br>Manager, Transport Standards Staff, ANM-110<br>Manager, Airframe and Propulsion Branch, ANM-112<br>Manager, Seattle Aircraft Certification Office, ANM-100S<br>Manager, Propulsion Branch, ANM-140S<br>Manager, Denver Aircraft Certification Office, ANM-100D<br>Manager, LA Aircraft Certification Office, ANM-100L<br>Manager, Propulsion Branch, ANM-140L | Policy No. | |

FAA personnel involved in use of visible dye penetrants for performing Nondestructive Evaluation (NDE) of safety critical engine, propeller and APU parts are advised to contact either the appropriate Engine and Propeller Directorate (EPD) personnel or the National Resource Specialist Nondestructive Evaluation (NRS NDE) before acting on such issues as they pertain to:

a. Certification.

b. Continued airworthiness.

c. Alternate means of compliance.

The use of visible dye penetrants is not recommended for the inspection of safety critical engine, propeller, or APU hardware. While visible dye penetrants do have limited crack detection capability, the constituents of visible dye penetrants are likely to deposit residue in crack voids. The residue can be extremely difficult to remove from cracks, regardless of the cleaning method employed. Cracks can become fully or partially masked by the remaining residue. Due to these characteristics, visible dye penetrants can make follow-on detection of existing cracks virtually impossible when using other NDE penetrant methods, specifically Fluorescent Penetrant Inspection (FPI). Use of FPI for NDE type defect inspections on engines, propellers, and APUs is common and widespread. Furthermore, the continued operational safety of most safety critical parts relies on periodic global or full field FPI. Visible dye residue contamination of fluorescent penetrant fluid is also known to significantly reduce the brightness of fluorescent indication.

Visible dye penetrants include AMS2644, Type 2 red dye penetrant, or any vividly colored dye penetrant visible under ordinary white light. AMS2644, Type 1, Fluorescent penetrants which are visible under ultraviolet light are considered different materials by standard practices and should not be considered a subset of visible dye penetrants. No standards currently exist for qualifying the sensitivity of visible dye penetrants.

Safety critical parts, are those parts of an engine, propeller, or APU whose failure is likely to cause a Continued Airworthiness Assessment Methodology (CAAM) level 3 or 4 hazard to the aircraft.

A CAAM level 3 hazard or event is a propulsion system or APU malfunction that causes :

a. Substantial damage to the aircraft.

b. Substantial damage to a second unrelated system.

c. Small penetrations of aircraft fuel lines or aircraft fuel tanks.

d. Significant damage to a second engine system.

e. Uncontrolled fires extinguished by on-board aircraft systems.

f. Rapid cabin depressurization.

g. Permanent loss of thrust or power greater than one propulsion system.

h. Inability to climb and fly 1000 feet above terrain.

i. Impairment of aircraft controllability.

A CAAM level 4 hazard or event is a propulsion system or APU malfunction that causes any of the following:

a. Forced landing.

b. Loss of aircraft (hull loss).

c. Fatalities.

d. Serious injuries.

Engine, propeller, or APU parts which can cause failures likely to result in a CAAM level 3 or 4 event, are considered poor candidates for visible dye penetrant inspections. Safety critical parts include, but are not limited to:

a. Propeller blades.

b. Propeller hubs.

c. Fan disks and hubs.

d. High pressure turbine (HPT) disks.

e. Low pressure turbine (LPT) disks.

f. High pressure compressor disks and drum rotors.

g. Cooling plates, shafts and spacers.

h. Crank shafts.

i. Pressure vessels.

j. Engine mounts.

k. Flywheels.

original signed by:

Thomas A. Boudreau,

Manager, Standards Staff,

Engine and Propeller Directorate

**Reference Documents**

1. ASTM-E-1417 Practice for Liquid Penetrant Examination

2. MIL-STD-6866 Military Standard Inspection Liquid Penetrant

3. MIL-I-25135E, Inspection Materials, Penetrants

4. AC 33.4B, Instructions For Continued Airworthiness: Focused Inspection Of Safety Critical Turbine Engine Parts At Piece-Part Opportunity (currently in Draft form)

5. AC 43.13-1b, Acceptable Methods, Techniques, and Practices Aircraft Inspection and Repair, September 8, 1998, chapter 5 Nondestructive Inspection (NDI), Section 5, Penetrant Inspection

6. AMS 2647b Fluorescent Penetrant Inspection - Aircraft and Engine Component Maintenance

7. AMS 2644a Inspection Materials, Penetrant